BY ORDER OF THE COMMANDER
AIR FORCE MATERIEL COMMAND

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Maintenance

DEPOT MAINTENANCE WORK MEASUREMENT

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction implements AFPD 21-1, *Managing Aerospace Equipment Maintenance*, AFI 21-102, *Depot Maintenance Management*, DoD Directive 5010.31, *DoD Productivity Program*, and DoD Instruction 5010.34, *Productivity Enhancement, Measurement, and Evaluation - Operating Guidelines and Reporting Instructions*, which require each DoD component to sustain a work measurement program. It also implements requirements in Volume 11B of DOD 7000.14-R, *Department of Defense Financial Management Regulation*. By means of work measurement, this instruction provides an avenue for continuous productivity improvement in depot maintenance industrial processes. It explains how to develop, revise, and validate depot direct labor standards and shop flow days (SFD). This instruction does not apply to the US Air Force Reserve or Air National Guard units and members.

SUMMARY OF REVISIONS

This revision adds a rewritten AFMCI 21-106, *Labor Classification*, as Chapter 2. It also adds procedures for calculating Personal, Fatigue, and Delay Allowances (PF&D), extracted from DoD 5010.15.1-M, as Attachment 9.

Chapter 1

INTRODUCTION

1.1. Introduction. This instruction provides guidance, procedures, and responsibilities for the AFMC Depot Maintenance Work Measurement Program, which addresses development, maintenance, and use of direct labor methods and standards, indirect labor factors, labor efficiency factors, and SFDs. It also covers internal control procedures to ensure these written practices are consistently followed. The program stresses integrity, reliability, and accuracy of labor methods and standards.

1.2. Purpose. The purpose of work measurement in the depots is to meet the requirements of both external and internal customers.

1.2.1. External customers:

1.2.1.1. Labor standards are used as a basis for costing and allocation of payroll hours required to perform individual work orders. Labor standards must accurately reflect the cost of labor to do any particular job. Also, labor standards are used to establish production schedules; they have a direct bearing on the length of the repair cycle that is portrayed to the customer.

1.2.1.2. Since labor standards are used to calculate standard SFDs, they also have a direct bearing on quantities of spares purchased by the item managers. Spares can be a significant cost to external customers.

1.2.2. Internal Customers:

1.2.2.1. Work measurement documentation provides the means to benchmark organization work performance. Labor standards are the projected times by which management can effectively evaluate actual organization work performance. Labor standards operation descriptions and associated times provide data for analysis that enable the repair process owners to identify prime areas for process improvement. Standards are used in scheduling, budgeting, sales rates, manpower requirements and shop capacity. Standard SFDs are used to calculate floating stock, where applicable.

1.2.3. The technique selected to conduct a work measurement study will be based on a positive return on investment. In other words, the anticipated savings should exceed the cost of measurement.

1.2.4. The information obtained from work measurement studies or analysis will be used to evaluate organizational performance.

1.2.5. For consistency of application, tools, techniques, and management data associated with work measurement will be automated and shared with other AFMC depots through the current labor standard mechanization system.

1.3. Responsibilities:

1.3.1. The Depot Maintenance Division (HQ AFMC/LGP) will formulate and administer policy guidance for the AFMC depot work measurement program. HQ AFMC/LGP will serve as the command representative on depot work measurement issues or matters requiring coordination with other agencies and services, or the Department of Defense as required.

1.3.2. Each center product directorate will:

1.3.2.1. Write an annual Work Measurement Plan for developing and reviewing labor methods and standards. The plans will be submitted to the center LG Work Measurement POC for validation. This procedure is designed to demonstrate that written policies are being consistently followed, as required by Cost Accounting Standards (CAS 407). (Note: References to product directorates are intended to include Technical and Industrial Support (TI) directorates.)

1.3.2.2. Submit periodic progress reports to center LG. As a minimum, the product directorates should submit a summary of results at the end of each year.

1.3.3. The Logistics Directorate (LG) at each center will:

1.3.3.1. Be the center focal point for administering the Work Measurement Program. LG will coordinate on all Industrial Engineering Technician training and reporting requirements, interpret policy guidance, investigate new software and hardware technology, and provide computer system management and functional support.

1.3.3.2. Validate annually the Product Directorate Work Measurement Plans. LG will also periodically review compliance with the plan. Reference work measurement plan, paragraph 2.2 of this instruction.

1.3.3.3. Have on file a center Annual Work Measurement Plan in support of the product directorates' plans.

1.4. Definitions. The AFMC depot maintenance work measurement program will use standard industrial engineering terminology and definitions acceptable by DoD. A comprehensive "Glossary of Terms" is available in the Standardization of Work Measurement, DoD 5010.15.1-M, basic volume, appendix IV, and serves as the source and documentation for the AFMC work measurement program definitions. Any variance in terminology or definitions for applicable industrial engineering terms will be addressed in writing to HQ AFMC/LGP for consideration and approval.

1.5. Training and Qualifications. Journeyman Industrial Engineering Technicians must be qualified in their job series. A shortened version of work measurement standards and concepts should be developed and given to supervision. Each engineering/planning organization will ensure the completion of proper work measurement training and related career development of personnel assigned to work measurement activities. These personnel will be afforded development opportunities through a planned program of training, continuing education, work assignments, and professional and technical activities. Refresher training should be given as required. Specific training requirements are included in attachment 2.

1.6. References. Organizations responsible for developing labor standards or managing AFMC depot maintenance work measurement programs will provide and maintain centrally located work measurement technical and related references. Recommended references are shown in Attachment 1.

Chapter 2

LABOR CLASSIFICATION

2.1. General.

2.1.1. The qualifying criteria for labor as described in this instruction is that the job being performed, whether it is classified as direct or indirect, must be paid for by the DMAG. This instruction does not apply to jobs falling outside this criteria. Throughout the remainder of this instruction, labor paid for by the DMAG shall be referred to as maintenance labor.

2.1.2. The prescribing regulation for labor classification is DoD 7000.14-R, Volume 11B, Chapter 63. The purpose of this chapter is to assist in applying the regulation.

2.1.3. Proper classification of maintenance labor is an aid to managers at all levels. It is a tool for achieving the most effective and economical utilization of human resources when combined with accurate reporting of workers' time spent on assigned tasks. It is also a tool for evaluating how well the work force has been managed against goals stated in performance indicators. The measurement of maintenance labor, especially direct, provides the baseline, or yardstick, against which labor management is measured. It should be noted that the classification of maintenance labor is based on the task performed, not on who does it.

2.1.4. Maintenance labor is classified as direct or indirect.

2.1.4.1. Direct labor is that labor which benefits the job order for which it is performed.

2.1.4.2. If an employee performs labor that cannot be identified to a specific job order on which they are working, then their time is indirect labor. Indirect labor has two categories which are called production overhead and general and administrative (G&A) overhead. When a particular job activity is determined to be indirect labor, each maintenance activity must decide if it should be classified as Production Overhead or G&A Overhead.

2.1.4.2.1. Production overhead labor is all other labor expended in a production division that does not meet the criteria for direct labor.

2.1.4.2.2. G&A labor is labor expended by personnel performing functions external to a production division.

2.2. Direct Labor.

2.2.1. The following three criteria apply to direct labor. Programmed maintenance labor that does not meet all three of these criteria, and non-programmed labor that does not meet the first two criteria, cannot be classified as direct.

2.2.1.1. The maintenance labor is identifiable to a specific JON. It must benefit only the job order for which it is performed. The task would not be performed except for the existence of the job order.

2.2.1.2. The maintenance labor increases the value or utility of a part, assembly, or end item.

2.2.1.3. The maintenance labor can be broken down into operations and suboperations, and the amount of labor required can be measured directly.

2.2.2. Direct labor is supported by official work requests and authorized by prescribed work authorization documents indicating the specific nature of the work to be done. Direct labor excludes efforts which benefit the overall organization as a whole. The number of direct labor hours chargeable to a job order are only those incurred during the period of time that benefits accrue solely to that specific job order. Direct labor must be assigned to a direct labor RCC, or direct labor time exceptioned to a direct labor RCC.

2.2.3. Direct labor for programmed workloads will be broken down into tasks and labor standards determined for each task, as specified in chapter 3. Labor standards will not be determined by prorating available time over the quantity of workload. Direct labor tasks will be documented on a Work Control Document (WCD) in accordance with AFMCI 21-110. The time expended on direct labor tasks will be documented in the appropriate time & attendance and production systems, such as Programmed Depot Maintenance Scheduling System (PDMSS), Inventory Tracking System (ITS), and Time and Attendance (TAA).

2.2.4. PAC certification will be in accordance with AFMCI 21-108.

2.3. Production Overhead Labor.

2.3.1. Production overhead labor can generally be subdivided into two categories: indirect time in a production Resource Control Center (RCC), and shop support overhead. Production overhead labor is all labor expended at the RCC level in the maintenance production functions that does not meet the criteria for direct labor. This includes tasks or functions that support direct labor or which are inherent to having a direct labor capability.

2.3.2. Indirect time includes supervision, clerical and administrative labor, annual leave, sick leave, and other paid leave. Also, functions such as attending administrative training or meetings are considered indirect labor when they involve people who are assigned to a direct RCC. The cost of this labor is apportioned over all products in the RCC rather than charged to one or more specific products.

2.3.3. Shop support overhead is labor expended by personnel performing functions above RCC level in support of the production division, and by personnel performing the primary mission of a staff or overhead function. This normally includes the functions of planning, scheduling, engineering, quality assurance, section, branch, and division direction. It is performed by people who are not assigned to a production RCC.

2.4. General and Administrative Labor (G&A). G&A labor is all labor not meeting the qualifications for either direct or production overhead labor. This includes supervision, clerical, and training. There is a valid requirement for production overhead and G&A overhead labor, which must be recognized separately and should not be hidden through improper conversion nor improper classification. The duty code assignment of personnel and subsequent man-hour exceptions should be based on recognition of the proper level at which the direct product labor costs are applied.

2.5. Relationship to Actual Labor Reporting. The reporting of actual labor utilization should be done in accordance with the appropriate AFMC instruction. The reporting of actual labor should reflect the classification of labor for the task each employee is assigned to do. Where an employee is temporarily assigned to perform a task classified different from normal assignments, the labor time spent in the temporary assignment must be reported based on the classification of the temporary assignment. For example, if a worker who normally does production overhead work, performs a direct labor task, then the time spent on that task must be reported as actual direct labor.

2.6. Responsibilities. The Engineering/Planning function at each ALC classifies maintenance labor and determines if the maintenance labor should be charged to a specific Job Order Number (JON). However, the final authority for interpreting this instruction and preparing local guidance for its implementation should be determined by each center and recorded in a local supplement to this instruction. Local supplements should be forwarded to HQ AFMC/LGP for review. Any deviation from the policies contained in this instruction must be approved by HQ AFMC/LGP before implementation.

Chapter 3

DIRECT LABOR METHODS AND STANDARDS

3.1. General. This chapter and related attachments address planning within the product directorates, conducting operational analyses, and developing, maintaining, and using labor standards at the depot.

3.2. Work Measurement Plan:

3.2.1. Each product directorate will develop an annual Work Measurement Plan and supporting procedures, which will be reviewed annually by the LG Work Measurement POC. At a minimum the plan will identify the standards to be reviewed, standards to be engineered, and highlight other actions planned for the year. Work measurement plans should address all standards; studies should focus on the high volume workloads or operations that provide a positive return on investment.

3.2.2. The product directorate may develop and use their own form with attachments as appropriate to document their plans.

3.2.3. The directorate plans will define which standards are to be reviewed during the year. All labor standards with current workload will be reviewed at least once every 3 years. If an inactive standard (no current workload) becomes active, the standard will be reviewed before loading the workload.

3.2.4. There are no established requirements for the product directorates to prepare or submit regular reports to HQ AFMC on the status of their work measurement program. Any data or information will be requested on an as required basis. The Work Measurement Plan and documentation of reviews will be made available to center/LG when requested. LG will provide assistance as needed to engineering and planning organizations during their review or study.

3.3. Establishment of Methods and Standards:

3.3.1. Definition. The definition of a labor standard that applies to the depot maintenance work measurement program is the time it should take a trained worker or group of trained workers, working at a normal pace, to produce a prescribed unit of work that conforms to technical requirements and standards according to a specified method under specific working conditions.

3.3.2. Operations Analysis (Study of the Method):

3.3.2.1. An operations analysis encompasses the procedures that the process owners consider, i.e., production, the purpose of the operations, methods used, inspection requirements, materials used, material handling, setup, tools, equipment, and working conditions.

3.3.2.2. The operations analysis is considered an integral part of developing labor standards. The analysis must be accomplished and recorded prior to the determination of a labor standard, and in the improvement of established labor standards.

3.3.2.3. An operations analysis should be based on a process chart, because of its wide application for describing and improving a method. The process chart is one of the most important tools for methods engineering in that it provides a graphic presentation of the process. Typical types of process charts include flow process chart, operation process chart, operator process chart, man and machine process chart, work place layouts, etc. The type of chart should be selected for a specific application. The level of detail may vary with type of standard.

3.3.2.4. The operations analysis must be documented in sufficient detail (technique and type standard dependent) to allow future reviewers to recreate the steps the original data developer used.

3.3.2.5. Long-term workloads identified as having good methods improvement potential will have a method study accomplished within the first year after production initiation. The requirements of a Methods Improvement Study are shown in paragraph 3.5.4.

3.3.3. Classification. Labor standards are classified as engineered or nonengineered. The current labor standards system includes statistical formulas for the classification of various types of work measurement data. Input data for each step or suboperation is identified as to work measurement technique; then accuracy and classification are mechanically determined. Accuracy formulas are shown in attachment 3. For an end item standard to be classified as engineered, at least 80 percent of its total standard hours must be classified as engineered.

3.3.3.1. Engineered labor standards must reflect a relative accuracy of plus or minus 10 percent with a 90 percent or greater confidence level at the operation level. For short operations, the accuracy requirement may be better met by accumulating small operations into operations whose times are approximately one-half hour.

3.3.3.2. Nonengineered labor standards are all labor standards not meeting the above criteria.

3.3.4. Techniques. All of the techniques shown below are acceptable when correctly applied. Labor standard techniques include:

3.3.4.1. Standard data (PACER FACTS II, DoD, AFMC Standard Data or commercially-available software). Policies concerning the establishment of methods time measurement (MTM)-based standard data elements require a level of accuracy equivalent to an engineered standard. When approved standard data is used to build a standard, the standard is classified as engineered.

3.3.4.2. Other engineering techniques (timestudy, group timing techniques, or work sampling). Formulas are available in attachment 3 to determine the accuracy of time study/group timing technique, or work sampling data. Therefore, these formulas can be used to determine the number of observations or samples required to classify data as engineered.

3.3.4.3. Regression and Correlation analysis. Standards developed using this technique will be considered engineered when the data used for the analysis is engineered.

3.3.4.4. Technical estimates. Based on technical orders (TO) or other factual data. This type of standard may be classified as engineered or nonengineered depending on the data cited.

3.3.4.5. Estimates. Judgmental standards set by engineering or planning personnel and process owners. This type of standard is classified as nonengineered, and should be targeted for conversion, where cost effective, using the work measurement technique with the best combination of accuracy and economy. Estimates must be broken down into a level of work units that allows confidence in the validity of the estimate. Include preparation and depreparation times when setting nonengineered standards. These times can be applied in two ways; in the personal, fatigue, and delay (PF&D) allowance in cases where the operator prepares for the entire shift (e.g., put on protective clothing), and in elemental times when the time is associated with an individual operation (e.g., get a special tool). The goal is consistency; to ensure the same amount of time is allowed and earned for performing like operations. PF&D will be displayed at the suboperation level for exchangeables and operation level for aircraft for non-engineered standards to clarify it as an allowance to be added to direct labor to arrive at standard time. This procedure will make the calculation of nonengineered standards consistent with the procedure for engineered standards. See section 3.3.9 for procedures on allowances.

3.3.5. Learning Curve. The labor standard will not incorporate factors which reflect the training techniques used and skill of personnel (learning curve effect). These factors are used in projecting labor efficiency (see chapter 4).

3.3.6. Recycle Time. The labor standard may include that recycle time inherent in the repair process that does not result from some action or inaction by the repair technician. The inclusion of recycle time must be based upon it being observed, studied, an occurrence factor developed, and allowable time added to the labor standard as an occurrence factor to a step or suboperation within a specific operation.

3.3.7. Performance Rating (Levelling). Performance rating is the act of comparing the actual performance of a worker against a defined concept of normal performance. Performance rating will be performed in conjunction with work samples, time studies, and other techniques where applicable. Since there are various systems of performance rating, it is up to the centers to choose an appropriate system. All technicians accomplishing performance rating must be currently certified in the system being used.

3.3.8. Occurrence Factors:

3.3.8.1. The frequency of occurrence for each element will be determined and the information recorded must be clearly identified to the operations, suboperations, or steps to which it applies. The frequency will be expressed as a percentage of element occurrence when all considerations of work requirements, moves and recycling are made.

3.3.8.2. Document the source of occurrence factor data; the method used to obtain the occurrence factor; any computations used to convert the source data into occurrence factors; and any special conditions which further explain occurrence factor development.

3.3.8.3. Additional information on ways to calculate occurrence factors is included in attachment 4.

3.3.8.4. "X" operations may be used to support shops performing process or batch type operations, i.e., plating, painting, cleaning, heat treating, etc. If "X" operations are utilized, the labor standards for these types of operations will be developed against the original resource control center (RCC) control number and will be established using an "X" prefix operation number. The "X" prefix in the operation number will replace the "M" in the RCC that is performing the support. For example: If plating support is required and the plating shop RCC is MNPPA, then the operation number will be XNPPA. There cannot be more than one "X" prefix operation per support RCC. Therefore, all support required within an RCC must be developed under the "X" prefix operation for that RCC.

3.3.8.5. Occurrence factors for "X" prefix operations will be 1.00. Occurrence factors for suboperations and steps will be developed to result in an end item time per unit.

3.3.9. Allowances:

3.3.9.1. Allowances for PF&D must be developed using procedures contained in Attachment 9 and included as part of the labor standard. When increased allowances are used due to temperature, lighting, or noise, actual readings must be documented.

3.3.9.2. There will be no subjectively assigned or applied special delay allowances. Special delay allowances must be supported by an engineered backup study of the work conditions.

3.3.9.3. The determination of a separate PF&D allowance for each labor operation performed may not be feasible due to the large number of operations in depot maintenance. Adequate allowances can be achieved through study and identification of different type work conditions and the application of preestablished allowances based upon these conditions. Each allowance will then be applied to all operations under the conditions associated with that allowance. There will be no "across the board" type increases or decreases in allowance category percentage without the support of an engineering study.

3.3.9.4. Allowances will be applied at the suboperation level for exchangeables and the operation level for aircraft. As a minimum, a suboperation/operation is defined as a work unit performed at one work station with one skill level. If the unit is moved to another work station, or a different skill level is required (e.g. system test to repair), a new suboperation/operation must be established to allow PF&D to be applied. When estimates and historical data are used for non-engineered standards, it may be necessary to first remove the allowance or a portion of the allowance from the basic time to prevent double counting. See Attachment 6 for examples of documentation.

3.3.9.5. Special condition (other). Time expended by direct labor personnel on the inventory of tools is placed in the labor standard when the inventory is required once per operation, end item, or movement to or from a work area. When the inventory is performed on a once per day frequency, the time is placed in the PF&D allowance as part of end-of-shift cleanup time. The percent of cleanup time for tool inventory (control) should be documented.

3.3.10. Coordination/Approval:

3.3.10.1. Labor standards will be coordinated with appropriate supervisory personnel for completeness of work elements and method content. It is recommended that coordination with production personnel be done prior to time measurement.

3.3.10.2. Coordinating agencies are allowed 5 workdays to express in writing reasons for nonconcurrence. If no reply is received within 5 workdays the standard is considered coordinated and acceptable. Insufficient labor standard time is not considered a valid reason for nonconcurrence.

3.3.11. Duration. Labor standards will remain in effect until revised according to paragraph 3.5 of this instruction, or retired to an inactive file.

3.4. Documentation of Standards:

3.4.1. Work measurement personnel must maintain sufficient documentation to comply with the provisions of this instruction, and also those of the product directorate plans. They will develop and maintain an active labor standard file that contains supporting and backup data for the labor standard. Backup material can be stored in a different location, or on a media different than paper, as long as a consistent procedure is followed and an audit trail is maintained. The use of electronic storage is encouraged, with the ability to print out documentation upon demand. Backup procedures must be in effect to prevent the loss or destruction of electronically-stored information.

3.4.2. A master file can be established for each standard having application in more than one RCC, or to more than one production number. Pertinent backup data should be maintained in this file to facilitate the establishment and audit of the standard. When backup data is used to establish a labor standard for another control number, a file number reference "To and From" will be made on the master and referenced files. This annotation will make it unnecessary to duplicate the backup material.

3.4.3. Documentation requirements for engineered standards are shown in attachment 5.

3.4.4. Nonengineered standards should include all available documentation, but as a minimum must specify the name of the industrial engineering technician and the date, the origin of the standard and the occurrence factor, the SFD calculations for commodities, PF&D calculations, and an historical record of any changes.

3.4.5. Copies of current local procedures that apply to work measurement will be provided to each center's LG Work Measurement POC.

3.5. Review/Revision of Methods and Standards:

3.5.1. Review. Since one of the basic tenets of work measurement is to work with the concept of continuous process improvement, product directorates will design and perform periodic reviews of owned standards. Engineering/planning personnel will also review active standards where significant activity exists, performance efficiency is out of tolerance, or upon valid request by work center supervisors. No review is required for inactive (unprocessed for at least 1 year), nonprogrammed labor standards, or labor standards on workloads being phased out within the next year. Inactive labor standards that have work measurement and methods data may need to be retained in an inactive file to preserve and support other engineering data and studies.

3.5.2. As a minimum, a labor standard review will contain all the elements described in Attachment 6.

3.5.3. Revision. Revision of work measurement standards is appropriate when evidence indicates that changes have occurred to the work process. Insufficient time allowed, or low performance efficiency are not acceptable reasons to warrant a revision to a standard. However, these may be reasons for further investigations. In the case of aircraft standards, product directorate personnel must inform the local Maintenance Requirements Review Board (MRRB) of revisions, so that planning documentation can be updated.

3.5.4. Method Improvement Studies:

3.5.4.1. Method improvement studies are an integral part of continuous process improvement. They are performed to provide managers with ideas and data on how to achieve optimal approaches to doing work. Each study should provide improvement and standardization of the methods, equipment, working conditions, and operator training. Candidates for method improvement studies should be selectively chosen from high labor intensive areas, suggestion programs, analysis of management information reports, feedback from the production work force, etc. Workloads identified as having good method improvement potential should have cost savings documented.

3.5.4.2. A method improvement study will document a clear description of the current work process, the proposed process, flow process charts for the old and new methods, and an analytical comparison of the two methods, as applicable. The work center supervisor or designated representative will review and coordinate with the new method description before the standards are set or revised, and subsequently report any deviations from the approved method.

3.5.4.3. In the case of new workloads direct labor costs must be documented in order to satisfy the requirement of the buying activity that the projected levels of productivity are reasonable and attainable. Ideally, projected direct labor hours are backed up by a methods improvement study, plus documented labor standards. In practice this work measurement continuous process improvement cycle may not coincide with the need to provide labor costs for new workloads. When this occurs, the projected times must be based on a combination of historical times, plus professional judgments based on programmed, documented changes (e.g., acquisition of new equipment, revised floor layouts, work content changes, etc.). As soon as the changes are implemented time variations must be recorded in order to provide evidence of attainability. In addition, realistic labor efficiency factors must be used to compute startup costs (see paragraphs 4.7 and 4.8).

3.6. Program Validation:

3.6.1. Each center LG Directorate is responsible for a control process to monitor the health of the product directorate work measurement programs. The primary focus will be on the overall effectiveness of the work measurement process, as opposed to in-depth examination of work methods. The validation must be so designed that program weaknesses and failures are identified and timely corrective actions taken. Written procedures will be developed locally describing expectations, validation techniques, schedule, and reporting level to be used in evaluating program compliance.

3.6.2. The work measurement program validation must determine:

3.6.2.1. The progress and attainment of work measurement program goals.

3.6.2.2. The effectiveness and timeliness of corrective actions.

3.6.2.3. The effectiveness and application of work measurement training by work measurement personnel.

3.6.3. When the validation takes the form of a statistical audit of active standards, the procedure in attachment 7 may be used.

3.6.4. Validation reports and notification of corrective actions must be retained on file for at least 3 years, and must be made available for review upon request.

3.7. Application of Standards:

3.7.1. Labor standards coverage.

3.7.1.1. All planned work will be covered by standards, either engineered, or nonengineered (estimates).

3.7.1.2. Labor standards coverage is based on DPSH. The DPSH for an organization are the summation of individual end item labor standard hours multiplied by the number of projected or actual units produced during the period being measured. Engineered labor standards coverage is the percentage derived from dividing the number of engineered DPSH by the total number of permanent programmed DPSH, including engineered and nonengineered hours. This metric, percent engineered standards coverage, is one commonly accepted measure of a work measurement program that is provided to outside agencies on an as required basis. When this calculation is made, the baseline total should exclude the following workloads:

3.7.1.2.1. Temporary or nonprogrammed workload.

3.7.1.2.2. Modifications or other permanent workloads with a life span of 18 months or less.

3.7.1.2.3. Support provided offsite.

3.7.1.3. The centers have the authority to decide where, and to what extent to apply engineered standards based on their competitive needs, and economic considerations, i.e., where anticipated direct labor savings exceed the cost of standards development. General guidelines for selecting which standards to engineer are contained in Attachment 8. There is no blanket, across the board numerical coverage goal, but appropriate goals based on return on investment should be set for individual areas and included in the product directorate work measurement plans.

3.7.2. Variance analysis:

3.7.2.1. Direct labor efficiency, earned standard hours divided by actual hours, is a measure designed to identify potential problems within a work organization, usually an RCC or work center. Significant variance between the projected labor efficiency and reported (actual) efficiency indicates a potential need for process improvements, and should be made clearly visible to the process owners for analysis, assessment, and process improvements as necessary. Continued variance should be reviewed at appropriate levels of management, as one of several measures of cost effectiveness and resource management.

3.7.2.2. Organizational variance analysis is covered in more detail in chapter 4, paragraphs 4.4 through 4.5, of this instruction.

Chapter 4

INDIRECT LABOR FACTORS AND EFFICIENCY

4.1. General. Indirect labor standards are established to account for labor expended by and for an RCC that is not accounted for by direct labor standards. These standards allow for the cost of indirect labor to be apportioned over all the products repaired in the RCC rather than charged to one or more specific products. To fully evaluate the cost of the items repaired by the RCC and to evaluate their performance, it is necessary to establish standards or allowances for supervisory, clerical, training, and other legitimate time expenditures and for annual, holiday, administrative and sick leave time. These standards or allowances are established and converted to annual factors. Sick and annual leave should be shown with a seasonal (periodic) variation and the factor for training adjusted for known variations.

4.2. References:

4.2.1. AFMCI 21-111, *Depot Maintenance Business Area (DMBA) Financial Operating Procedures*.

4.2.2. AFMCM 177-5, *Maintenance Labor Distribution and Cost System (G037G).*

4.3. Indirect Labor Factor Procedures. Standard indirect labor factors for budgeting, cost accounting, planning, and reporting are developed and distributed by engineering/planning or the responsible function, obtaining coordination from other organizational components as required. These factors are established for the fiscal year and are not to be changed unless a significant change in workload or organization occurs. The technician must determine the standard time required by the RCC to support its direct labor in each indirect category. Once this standard time has been established, it is converted into an indirect factor by dividing the standard by the total direct hours available to the RCC.

4.3.1. Use the following procedures for establishing factors for indirect labor (excluding leave):

4.3.1.1. Accumulate all pertinent data available, for example, historical, job description, etc.

4.3.1.2. Determine work elements in each account.

4.3.1.3. Evaluate each work element using accepted work measurement techniques, for example, work sampling, timestudy, frequency studies, etc.

4.3.1.4. Total the elements for each account and express as a percent of projected direct labor.

4.3.1.5. Coordinate indirect labor factors with affected supervisory personnel as to completeness of the work elements.

4.3.1.6. Justify the indirect factors by sufficient data for normal confidence in their accuracy. Where the use of work measurement techniques is not feasible nor cost effective, historic data will be considered adequate.

4.3.2. Establish indirect labor factors for leave using historical records and backup data. Annual leave should be computed on the basis of total leave accumulation within the RCC. Local base policies generally exist to govern the use of sick leave. Annual leave should generally be prorated with a periodic variation that might be reasonably expected. Other type leave (holiday, administrative, etc.) is grouped under cost code .33 for accounting purposes. Leave factor allowances are computed on the basis of projected direct labor and used as a factor of direct earned hours.

4.3.3. Standard indirect labor factors are compiled and distributed to the appropriate budgeting, cost accounting, planning, and management organizations. These factors will be broken out by month and the element of leave will include factors for cost code .31 annual leave; .32 sick leave; and cost code .33 holiday leave. Backup data for the indirect labor standards and the indirect labor factors for the fiscal year in which they are used will be filed in the appropriate responsible organization.

4.4. Labor Efficiency Variance. Analysis of the variance between the RCC projected labor efficiency and the reported (actual) labor efficiency can identify the organization's potential productivity improvements.

4.4.1. Labor efficiency, defined as earned (standard) hours divided by actual hours, will be used for its intended purpose as a management tool for pinpointing potential workload or organizational problems. When potential problems are indicated, engineering/planning will be requested to do the following:

4.4.1.1. Identify the variance to study.

4.4.1.2. Define the makeup of this variance and quantify the various components.

4.4.1.3. Design a specific get-well or improvement plan and coordinate with all parties concerned.

4.4.1.4. Report and track the findings and the progress to resolve the problems at all levels of management.

4.5. Responsibility:

4.5.1. Variances should be reviewed by engineering/planning, with input and coordination by production supervision. Not all labor efficiency variance issues can be, or should be resolved by engineering/planning. The variance can be a result of many factors requiring a number of different organizations involved in the solution. The variance may include potential areas for improvement as a result of:

4.5.1.1. Inadequate resources (e.g. technical data, tooling and equipment, facilities).

4.5.1.2. Inadequate material support (e.g., no parts, late parts, poor parts movement, rob-back).

4.5.1.3. Technical problems (e.g., procedures and methods, technique sensitive).

4.5.1.4. Personnel (e.g., improper skill mix, insufficient training, learning curve, poor supervision).

4.6. Labor Efficiency Factors. Labor efficiency factors will be developed and documented. The projected factors will be coordinated with the responsible levels of management.

4.7. Procedures:

4.7.1. Projected labor efficiency factors are developed for each RCC on an annual basis, and prepared for shop floor control system input.

4.7.2. This guidance is provided so that these factors may be developed on an objective basis. The specific conditions covered below are actual existing conditions and may not be accounted for in the development of labor standards or the use of PF&D factors.

4.7.3. Labor efficiency factors are developed by projecting the effect of the following conditions on labor efficiency. The projection should be accomplished using sound industrial engineering practices. Justification must be kept on file and available for audit purposes.

4.8. Conditions. The following are the most important conditions which can influence historical and projected labor efficiency:

4.8.1. Workload Mix. Defined as the number of different items and the volume of each item per period.

4.8.1.1. Changes in workload mix may cause changes in labor efficiency because of the effect of labor standards based on a projected level of workload volume per period.

4.8.1.2. Changes in workload mix, which are inconsistent with the current assignment of personnel and skills, may cause some workers to be assigned to the repair of certain items with which they are not familiar. This may cause more time for research of technical data, safety requirements, and quality requirements.

4.8.1.3. Changes in workload mix may cause temporary tool or equipment shortages which can disrupt a smooth work flow.

4.8.1.4. Some processes may be preidentified as being sensitive to workload volume or mix changes.

4.8.2. Tooling and Equipment:

4.8.2.1. Changes in equipment downtime may cause disruptions to smooth work flow and completion of items. This is normally related to equipment age and rate of usage.

4.8.2.2. Lack of sufficient equipment may cause inefficiencies. This may result from insufficient lead time in the acquisition of required tooling and equipment.

4.8.3. Training of New Personnel. On-the-job training and new or reassigned personnel when new skills must be acquired will affect efficiency.

4.8.4. Product Quality. Changes in reject rates and rework effort may impact the labor efficiency.

4.8.5. Learning Curve. For new workloads or major changes in work requirements, personnel will begin at a relatively low performance level and improve with the repetition of repair actions. The impact of this on labor efficiency depends upon the amount of experience with the workload and the size of new workload in relation to the total RCC workload. See the References appendix for sources of information on learning curves.

Note: Compensation for this condition is incorporated in the labor efficiency factors and not the labor standard itself.

4.8.6. Shift Worked. Changes in the number of shifts worked or changes in the relative percentage of total work by shift may impact labor efficiency. This change is caused by such things as a reduced amount of support available (material, materials handling capability, etc.).

4.8.7. Material Support. A change in the level of material support may impact the labor efficiency. This may be caused by time spent by mechanics getting material, waiting for material, or changing from one job to another because of material unavailability. The size of the awaiting parts inventory may be an indicator of material support problems.

Chapter 5

SHOP FLOW DAYS (SFD)

5.1. Background. In order to ensure combat units of the Air Force have the required equipment at the right time and place, ready for instant use, AFMC must maintain the ability to replenish base stock levels through the constant flow of recoverable material to and from globally-deployed units. This material flow is known as depot repair cycle time (DRCT), commonly called pipeline time. One of the most important segments of DRCT is SFD. Over or understatement of SFD standards creates unrealistic provisioning of spares and erroneous repair requirement computation. This results in critical items and stock shortages or unneeded stock. Consequently, the importance of establishing accurate SFD standards cannot be overemphasized. This directly relates to objectives of the AFMC Mission to enhance the competitiveness of our operations by improving throughput, and decreasing inventory and operating expense. We need to measure what we do, (standard SFD), and then work toward reducing actual SFD, through process improvements, application of theory of constraints, etc.

5.2. SFD Standard. The SFD standards are computed estimates representing the planned number of calendar days required to process an end item, measured from the time the item is received in the product directorate to the day of serviceable turn-in. SFD standards are based on a summation of direct labor standards for individual operations. The labor standards can be engineered, or nonengineered, but the basis or method of developing the standard and the length the standard is good for must be disclosed in writing. The standard flow time development assumes that all assets and parts are available when the item is scheduled into the repair process. Delay time for multiple assets inducted on the same work order will not be included in SFD unless the approved repair process authorizes the batching of items; therefore this delay time will not be part of the process support factor in the SFD standard. The standard is input to the shop floor control system where it is used in the computation of repair and buy requirements. The standard also supports the workload planning, scheduling, and negotiation functions.

5.3. SFD Development. SFD standards for components are developed by summarizing labor standards representing the setup and run time for each operation the component flows through in the repair process, plus process delay times, including move and queue times between operations. The resultant elapsed time, expressed in hours, is then converted to calendar days by multiplying the hours by a conversion factor and dividing by the hours worked per week. The planner must furnish the component calculated flow days to the originating or responsible RCC planner, who, using a network charting technique, graphically displays the flow data for all components, enabling a logical end item depot flow time standard to be established. All planners who develop the SFD standards must review them as follows: with labor standard audit or review programs; when major changes in the repair process occur; or upon request of the customer. Documentation requirements of the review are shown in Attachment 6.

5.4. File Maintenance of Standards. Each engineering planning section, or equivalent responsible unit, develops and maintains the standard flow days. All flow day computations, including backup data, must be retained in the planning package. The engineering planner who develops the SFD standard must ensure the SFDs input to the current shop floor control system match those in the planners files. Maintain according to AFMAN 37-139.

5.5. SFD Standard Computation. The following formula is used to compute SFD standards in calendar days. The resultant decimal is rounded up to whole days.

SFD = 7.3[(S/I)+P]/(DH) where:

7.3. = 7X (260/250). The 7 converts time in weeks to time in days; 260/250 converts weekdays per year to workdays so that the 10 federal holidays are accounted for.

S = Standard hours. Includes all occurrence factors for all repair frequencies, and PF&D. When an operation with a labor standard takes place concurrent to a process support or unique process support operation (factor P below), only include the standard time for the longer of the two in the equation. Also include all work done on the end item within the RCC when the work consists of sequential operations performed by one worker only. For work consisting of concurrent operations or operations performed by multiple workers, the labor standard must be reduced accordingly. Only include the standard time for the longest concurrent operation (critical path). Reduce the standard time for operations performed by multiple workers by dividing the operations standard by the number of workers.

I = RCC constant--direct labor percent factors expressed as a decimal of productive hours available per shift. The RCC direct labor percent factor is determined by removing the RCC yearly average indirect category time values (that is, duty codes .24, .25, .26, and .29) from the 100 percent availability. (The percentage factor for janitorial services in code 26 is not to be included in the development of the RCC yearly average.)

P = Process support--Develop an average time value for required process steps, both process related and general. These times will be expressed in hours. Includes all occurrence factors for all repair frequencies. Examples of process related time include plating, curing, heat treat processes, test warm-ups, etc. General process time includes end item transportation time, queue time, etc. Allowances may also be included, on a pro-rated basis, for planned delays and transportations such as equipment down for periodic calibration and maintenance, and transportation of material from supply. Process support time concurrent to a longer labor operation time is not included. This will not include storage time for awaiting parts. An average process support factor will not be a blanket time value. Backup studies will be used to the extent possible, and must be retained for audit purposes.

D = Days per week (4, 4.5, 5, 6, or 7)

H = Hours per day in work (7.7 to 24)

Note: There may be instances within an RCC where single shift and multishifts coexist. In such cases, caution must be exercised in computing the SFD standard.

5.6. Computation Example.

S = 3 standard hours

I = 87 percent = .87

P = 4 hours transportation time + 8 hours test warmup = 12 hours

D = 5 day workweek

H = single 8 hour shift

7.3 [(3 / .87) +12] /(5X 8)

7.3 (3.45+12)/40

2.82, which is rounded up to 3.0 calendar days

Note: When a production number has support shop operations, the support shop planner will provide the SFDs (to two decimal places) to the network planner for consolidation and input to the shop floor control system.

5.7. Actual SFDs. Actual SFDs represent the actual number of calendar days required to process an end item, measured from the time the item is placed in work in the product directorate to the day of serviceable turn-in. The average actual SFDs will be compared with the standard SFDs by the responsible planner to determine if the standard SFDs require adjustment, or if other actions are needed to improve actual conditions impacting actual flow days. An analysis of the SFDs for the items comprising the top 20 percent of the DPSH in each product directorate will be performed annually. Analysis in most cases will pinpoint causes in actual flow day variance. This data must be available for headquarters review during staff visits to field activities or on site visits. The standard must be changed if workload content or shop flow layout change, or if other process improvements occur. Standard SFDs are not to be erroneously manipulated by factors affecting actual SFDs.

THOMAS W. BATTERMAN, SES
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Attachment 1

GLOSSARY OF REFERENCES

References

DoD 5010.15.1-M basic volume (with appendices), *Standardization of Work Measurement*

DoDD 5010.31, *DoD Productivity Program*

DoDI 5010.34, *Productivity Enhancement, Measurement, and Evaluation - Operating Guidelines and Reporting Instructions*

DoD 7000.14-R, Volume 11B (including CAS 407), *DOD Accounting Manual*

AFI 21-102, *Depot Maintenance Management*

AFMAN 37-139, *Records Disposition Schedule*

AFMAN 38-208, Volume 1, *Air Force Management Engineering Program (MEP) Processes*

United States Army Management Engineering College (AMEC) courses, *Defense Work Methods & Standards (Volume I- Methods Study, Volume II-Work Measurement, and Volume III-Work Projects) (obsolete)*

Commercially available, *"Handbook of Industrial Engineering," Maynard, Salvendy*

Commercially available, *"Motion and Time Study," Mundel*

AFMCR 66-55, *Mission, Design and Series (MDS)/Project Workload Planning*

AFMCR 66-61, *Equipment Maintenance Operational Planning*

AFMCI 21-108, *Production Acceptance Certification (PAC) and Organic Depot Maintenance Quality*

AFMCI 21-110, *Use of Technical Data in Organic Depot Maintenance*

AFMCI 21-111, *Depot Maintenance Business Area (DMBA) Financial Operating Procedures*

AFMCI 21-125, *Management of Depot Maintenance Programs*

AFMCR 21-130, *Equipment Maintenance Material Control*

AFMCM 177-5, *Maintenance Labor Distribution and Cost System (G037G)*

Attachment 2

TRAINING AND QUALIFICATIONS

A2.1. Personnel directly involved in establishing or reviewing labor standards must be trained in methods and standards concepts and techniques. All work measurement practitioners must successfully complete appropriate training. A shortened version of work measurement standards and concepts should be developed and given to supervision. Minimum required training includes:

A2.1.1. DoD Work Methods and Standards (DWMS).

A2.1.2. AFMC Standard Data. Additionally, Methods Time Measurement 1 (MTM-1) or equivalent is required for technicians who develop standard data.

A2.1.3. Labor Standards Mechanization (E046), MDS/Project Workload Planning System (G037E) and Programmed Depot Maintenance Scheduling System (G097) for aircraft, and Job Order Production Master (G004L), as applicable.

A2.1.4. Planning functions. Must include training in blueprint reading, engineering drawings and work specs, technical orders, Time Compliance Technical Orders (TCTOs), process orders, temporary work orders, and Work Control Documents (WCDs), per AFMCI 21-110.

Note: Duplicative material or requirements may be waived for persons having an associate degree in Industrial Engineering Technology or a bachelor's degree in Industrial Engineering.

A2.2. Lead engineers, technicians or supervisors approving labor standards must be familiar with the industrial engineering techniques applied.

A2.3. Persons using work measurement techniques requiring performance rating (or leveling) must be able to rate within plus or minus 10 percent of standardized ratings as set forth in Society for Advancement of Management films or other acceptable training methods chosen by AFMC, United States Air Force, or DoD. Annual performance rating, refresher training and proficiency certification are required for these persons. Complete files are maintained within the engineering/planning organization on each person's performance rating skills.

Attachment 3

ACCURACY FORMULAS

A3.1. Time (Stop Watch) Study and Group Timing Technique.

A3.1.1. There are many references containing formulas and procedures for the statistical analysis of time study data. These procedures are based on the number of cycles, the mean time, the range between cycles, and the standard deviation. Repetitive time study accuracy is established at the elemental level. For nonrepetitive time studies, accuracy is established at the cycle level.

A3.1.2. The formula below represents an accurate method of determining the statistical validity of study data:

$$S = \frac{(SD / \sqrt{N})(T)}{\overline{X}}$$

Where:

S = Relative accuracy

$\overline{X}$ = The arithmetic mean of the time values

SD = Standard deviation

N = Number of samples

T = The (N-1) t value (See t table A3.1.)

Table A3.1. t Table.

N	T	N	T
1	3.078	11	1.363
2	1.886	12	1.356
3	1.638	13	1.350
4	1.533	14	1.345
5	1.476	15	1.341
6	1.440	16	1.337
7	1.415	17	1.333
8	1.397	18	1.330
9	1.383	19	1.328
10	1.372	20	1.325

Note: Table A3.1. is from "Probability and Statistics for Engineers," Irwin Miller, John E. Freund, for a 90 percent confidence level.

A3.1.3. The level of accuracy required should be the highest attainable, based upon the type of work being performed. Highly repetitive, short-cycle operations must have high quality standard times (+

or - 10 percent). Highly variable repairs may not have consistent times from occurrence to occurrence, particularly at the elemental level. Consequently the development of statistically accurate times may not be attainable within practical and attainable limits.

A3.1.4. A finite number of time study observations should be made for highly variable work elements to ensure proper and economical use of the industrial engineering resources. The precise number can be determined by establishing a minimum number of cycles to be observed and calculating the accuracy after this minimum has been measured. If the accuracy is unacceptable, a specific number of additional cycles can be observed, and a new accuracy calculation made. If a significant improvement has not been achieved, the study should be stopped and the current level of accuracy accepted and reported for the standard. All supporting study data will be maintained as an audit trail.

A3.2. Work Sampling:

A3.2.1. The following formulas are used to determine the relative or absolute accuracy of work sampling data:

Relative: $$SR = Z\sqrt{\frac{(1-P)}{(N)(P)}}$$

Absolute: $$SA = Z\sqrt{\frac{P(1-P)}{N}}$$

Where:

SR = The relative accuracy expressed as a decimal.

SA = The absolute accuracy expressed as a decimal.

Z = The number of standard errors.

= 1.645 for 90 percent confidence level.

P = The percent occurrence expressed as a decimal.

N = The number of observations.

A3.2.2. Compute SR or SA according to the above formula. When absolute accuracy is used, the SA = SR(P) relationship will hold true.

A3.2.3. To determine the number of work sampling observations required to attain a specified statistical accuracy at a desired percent confidence level, the following formulas are used:

RELATIVE: $$N = \frac{Z^2 \ (1 - P)}{SR^2 \ (P)}$$

ABSOLUTE: $$N = \frac{Z^2 \ P (1 - P)}{SA^2}$$

To use the above formulas, the value of P must be estimated before the study. The formula may also be used at various points in the study to determine progress toward a predetermined statistical accuracy.

Attachment 4

OCCURRENCE FACTORS

A4.1. Data collection used for occurrence factors requires the same statistical analysis as the work measurement technique dictates.

A4.2. In the past occurrence factors have caused many Engineered Standards to be declared invalid because the backup data was not maintained.

A4.3. Defining occurrence factors -- The development of labor standards requires that each operation, suboperation, and/or step be reviewed for *FREQUENCY*, another name for occurrence factor. Simply put, frequency is that percent of the time an action, task or process occurs during the completion of a work cycle (completion of repair on a particular end item/asset). Another way to relate occurrence is the relationship to the next higher assembly or the unit of production count.

A4.4. The total time value of the labor standard is the sum of the operations times the frequency of each operation. An operation is the sum of all suboperations under that operation, times the frequency of each suboperation, a suboperation is the sum of all steps under that suboperation times the frequency of each step.

A4.5. Occurrences are expressed as a percentage; however, inputting uses the decimal equivalent. Inputting the frequency is three to the left and two to the right of the decimal; i.e., 125 percent would be input as 1.25. The minimum percent of time is .01 or 1 percent; the maximum is 999.99 times. If more is required, use additional steps, suboperations, or operations.

A4.6. There are at least 10 different ways to calculate an occurrence factor:

A4.6.1. Arithmetic mean -- Derived by dividing the sum of the values of applicable data by the number of data elements involved. This data may be from either observation or obtained from other records. Workload data will normally come from a sample of the total population.

A4.6.1.1. Examples:

A4.6.1.1.1. Average number of parts per item as observed from TOs and workload figures.

A4.6.1.1.2. Average number of items obtained per trip.

A4.6.1.1.3. Average number of paces per trip.

A4.6.2. Calculated Ratio -- The physical characteristics of the work situation are such that the occurrence can be calculated without introduction of errors.

A4.6.2.1. Examples:

A4.6.2.1.1. Number of selections required to select the correct leads from a number of leads.

A4.6.2.1.2. Number of times an object must be turned to select the proper side.

A4.6.2.1.3. Number of screws to install a panel when the time value is per screw installed.

A4.6.2.1.4. Number of square inches to be cleaned for a geometric configuration when it is constant from cycle to cycle and a "per square inch" time value is to be applied.

A4.6.3. Observed Proportion -- There are situations where only one of a group of tasks can occur at any given time. Over an extended period of time, each event/task must occur. Each event proportion will be the percentage of the total observations divided by the observations for that particular event or task. The sum of all proportions will equal 100 percent.

A4.6.3.1. Examples:

A4.6.3.1.1. Proportion of removal of a threaded fastener with resistance.

A4.6.3.1.2. Using multiple tools on a task; i.e., removing a nut from a bolt, using a screwdriver and an open-end wrench. What proportion of the task used the screwdriver versus the wrench. Both the screwdriver and the wrench time values must be on a part of a turn.

A4.6.4. Physically Determined -- The physical characteristics of the work are such that the occurrence is determined by looking at the item or the related technical data. No error is induced.

A4.6.4.1. Examples:

A4.6.4.1.1. Number of bolts per specific end item.

A4.6.4.1.2. Distance between anchors to be safety wired on an end item.

A4.6.5. Method Determined -- Determined by the analyst specifying the sequence of operations and prescribing standard conditions. The majority of the occurrence factors will be 100 percent. No error induced.

A4.6.5.1. Examples:

A4.6.5.1.1. Obtain parts from bin.

A4.6.5.1.2. Regular elements occurring once every cycle.

A4.6.5.1.3. Standard data to perform a specific task.

A4.6.5.1.4. Under certain safety situations, regulations require two or more people to be in attendance. Under most circumstances the "safety" people will be working on their own tasks and not charged to the tasks being measured; however, if these people are required for safety and have no other tasks, then the time will be occurrenced as more than one worker (larger than 100 percent).

A4.6.6. Support Shop -- The origin planner asks for backshop support. One of the data items to input is "OCC FAC," which will either be estimated or taken from production records. In each case, they should be reviewed during negotiations with the backshop.

A4.6.6.1. Example:

A4.6.6.1.1. Origin planner sends a part to be painted and has determined that the occurrence factor is 50 percent; however, later the customer or item manager determines this will be required 100 percent of the time. The origin planner must then update his planning documents with the new data.

A4.6.7. Recycle Factor -- Tasks that haven't been completed for one reason or another are classified as recycle. These are not tasks caused by operator error (rework). Rework is not included in the occurrence factor. Recycle tasks will be 100 percent plus whatever extra time is required.

A4.6.7.1. Example:

A4.6.7.1.1. End item test failure. Many test stands are programmed to stop at the first failure, indicating what part or area has not met the required specifications. The unit is repaired as the test stand has indicated, then retested for either pass or fail. This is true "recycle" time and is included as part of the "should take time" by prorating the test time over 100 percent.

A4.6.7.1.2. If the "repair after test" time is a separate task from "repair" then the prorated time does not have to be 100 percent plus, but carried as the actual percentage observed.

A4.6.7.1.3. When the operator has omitted a sequential task, regardless of the reason, the omitted time is "recycle" time; however, any time required to disassemble/assemble so the omitted task can be completed is rework and cannot be credited.

A4.6.7.1.4. When an installed part has proven to be defective, the time to reinstall a new part is classified as "recycle" time and prorated by the occurrence factor.

A4.6.7.1.5. Work normally required to hand fit or correct inherent deficiencies of an assembly will be occurrence factored.

A4.6.7.1.6. Unavoidable calibration, adjustments or unpredictable work done as the result of an inspection or test and the necessary retests.

Note: Rework is any work done on an item to correct work previously done due to operator error.

Rework will not be included in the direct production labor standards. The workload generated through rework requirements must be isolated for special considerations. This isolation of rework would result in a variance of the earned hour report and operating cost reported.

A4.6.8. Historical Data -- May be used to determine occurrence factor.

A4.6.8.1. Example:

A4.6.8.1.1. Completed work control document.

A4.6.8.1.2. Monthly production count summary.

A4.6.8.1.3. Routing slip history file.

A4.6.9. Technical Data Requirements -- An occurrence factor dictated by applicable TO technical data.

A4.6.9.1. Example:

A4.6.9.1.1. Time compliance technical order (TCTO).

A4.6.9.1.2. Occupational Safety and Health Act (OSHA) regulations.

A4.6.9.1.3. Directives from the item manager.

A4.6.10. Study Determined -- Occurrence factors which are study determined are based on the number of times the event occurs during the development of a labor standard.

A4.6.10.1. Example:

A4.6.10.1.1. A ten-cycle study (previously determined to be representative of the work load) was completed with the required statistical accuracy for an Engineered Standard. One of the elements had only two (2/10) occurrences (nonengineered); therefore, an occurrence factor of 20 percent.

A4.6.10.1.2. An element with identical work content (right and left hand subassemblies installed) will have an occurrence factor of 200 percent providing the element description reads "install right and left hand subassemblies."

A4.7. The data can be developed from several different sources such as:

A4.7.1. Data collected while doing the work measurement study.

A4.7.2. Data taken from the work control document.

A4.7.3. Data taken from the test stand. Some test stands have, as part of their input, serial number indicator to give a count at end of tests.

A4.7.4. Historical data (work control documents, shipping records, etc.).

A4.7.5. All recycled work, work controlled by the test equipment, not by worker error or neglect, is considered as "should take time," requiring an occurrence factor.

A4.7.6. Material usage records.

A4.8. Documentation of occurrence factors must be maintained in the labor standard jacket to provide an audit trail. The following must be documented for backup:

A4.8.1. Source -- Reason occurrence required.

A4.8.1.1. Method -- Technique used.

A4.8.1.2. Conversion factors.

A4.8.1.3. Special conditions.

A4.9. The documentation requirements may be hand scribed (legibly) on documents which already exist in the Labor Standard Jacket/File. The recorded information must be clearly defined as to the operation, suboperation or step to which the occurrence applies. Data may also be a part of any computer output product, generally on a supplementary line, as long as it provides an audit trail.

A4.10. As in all work measurement techniques used to develop Engineered Standards, the analyst must be assured that a "representative sample" of the workload has been observed. The absolute minimum number is three units; however, with the high variability in our workload, an agreement must be made between the Industrial Engineering Technician and the production shop to determine a realistic quantity.

A4.11. All labor standards are an average time; therefore, the larger the sample the better the statistical reliability will be. There comes a point in time where it is not economically feasible to study a task any longer, but it must meet the statistical accuracy of plus or minus 10 percent at 90 percent confidence level in order to be classified as an engineered standard.

Attachment 5

DOCUMENTATION FOR ENGINEERED STANDARDS

A5.1. Engineered labor standards must include as a minimum:

A5.1.1. Documentation of an operations analysis.

A5.1.2. A record of standard practice or method followed when the standard was developed.

A5.1.3. A record of rating or leveling observed during performance where applicable.

A5.1.4. A record of the standard time computation including explanation of PF&D allowances.

A5.1.5. A record of observed, synthesized, or predetermined time system time values used in determining the final standard time, e.g., data collection sheets.

A5.1.6. A minimum of 80 percent of the normal time associated with the labor effort covered by the standard will be derived from recognized industrial engineering techniques in which the statistical accuracy requirement can be demonstrated to meet the above.

A5.1.7. Occurrence factor calculations and supporting backup data.

A5.1.8. An "Historical Record Change" memorandum explaining the reason for each labor standard increase or decrease in standard time. This requirement includes changes in the standard practice (method) which is implemented but does not impact the standard time sufficiently to require alteration.

A5.1.9. Flowchart or diagram.

A5.1.10. Work area layout.

A5.1.11. SFD standard computations (for commodities only).

A5.2. This documentation must be maintained in files, either paper or electronic, by engineering or planning personnel.

Attachment 6

LABOR STANDARD REVIEW REQUIREMENTS

A6.1. Purpose: To specify the requirements for performing a labor standard review, and the documentation that must be retained to substantiate the review. Each labor standard review must be annotated with the name of the responsible industrial engineering technician and the date the standard was reviewed. The names of any personnel consulted during the technical review must also be listed. The documentation requirements for the annual calculations of Personal, Fatigue & Delay (PF&D) and labor efficiency factor are also included, since both are covered in AFMCI 21-105 as part of the work measurement program. PF&D must only be recalculated annually if the allowance is dependent on the workload mix, such as an aircraft workcenter where a percentage of the planes are worked outside; otherwise, PF&D should be revalidated during the regular review. While it is up to the centers to decide which organization is responsible for projecting the labor efficiency factor, it is important that organization maintain supporting documentation, since this factor directly affects end item sales price.

A6.2. Technical Orders (TOs):

A6.2.1. Verify the current TO number is valid, and check all changes to the TO since the last review.

A6.2.2. If there are no changes to the tech order since the last review, annotate this fact. If there have been changes, an annotation should be made as to whether the changes affect the standard.

Examples of annotations:

1. T.O. 00-125-2346 change no. 6 dated 1 Feb 97 was reviewed. There were no changes to the process since the previous review.

2. T.O. 00-125-2346 change no. 6 dated 1 Feb 97 was reviewed. The changes were discussed during the labor standard/occurrence factor/work control document (WCD) review.

A6.3. Work Control Document (WCD). Review the WCD, with technical personnel where required and make an annotation.

Examples of annotations:

1. The WCD was reviewed with Joe Smith/LAPNE and no changes were required.

2. The WCD was reviewed with Joe Smith/LAPNE and was revised on 1 Mar 97 based on changes to the T.O. (see attached).

A6.4. Labor Standard Hours: Labor standard hours will be validated through one of the following methods:

1. Work sampling study, time study, or other engineering technique.

2. Variance analysis comparing actual direct labor hours required to standard hours.

3. Estimate. Estimates must be accomplished at a level of work units that allows confidence in the validity of the estimate.

Examples of annotations:

1. Due to the addition of a new cleaning step to suboperation 0010 in the latest revision to the T. O. the suboperation time was increased from 1.2 to 1.5 hours per discussion with the engineer John Johnson/LAEA.

2. There were no requirement or process changes since the last review, therefore the current standard of 6 hours is accurate, per discussion with the engineer John Johnson/LAEA.

3. Analysis of actual direct labor hours required for FY97 showed the operation is actually taking an average of 5.75 hours. After discussion with Jimmy Jones/LAEC the standard is being lowered by 0.25 hours.

A6.5. Occurrence Factor. Occurrence factors should be validated against current, forecast technical/failure changes, or recent historical data. Either an annotation should be made or a copy of the report showing the occurrence factor should be added to the file.

Example of annotation:

The G037E occurrence factor report dated 15 Oct 97 showed an actual occurrence factor for the operation to be 0.80 for the last 12 months. Following analysis it was determined that the operational occurrence will continue at the 0.80 level. The occurrence factor was updated 1 Nov 98.

A6.6. PF&D. PF&D calculations must be revalidated annually. PF&D allowances must be calculated by resource control center (RCC)/skill code.

Examples of annotations in the PF&D calculations themselves:

1. Reviewed shop conditions with the supervisor Jim Jones/LIPEM. Shop conditions have not changed so the previous PF&D of 10% is still valid.

2. Reviewed shop conditions with the supervisor Jim Jones/LIPEM. Due to new environmental requirements additional personal protection equipment (PPE) is required, so the PF&D was recalculated to 14% (see attached).

PF&D allowances are applied to standards at the suboperation level for exchangeables and operation level for aircraft. As a minimum, a suboperation/operation is defined as a work unit performed at one work station with one skill level. If the unit is moved to another work station, or a different skill level is required (e.g. system test to repair), a new suboperation/operation must be established to allow PF&D to be applied. When non-engineered standards are based on actual hours or estimates, it must be clear from the documentation that PF&D was not double-counted.

Examples of annotations for the labor standards:

1. The standard of 50 hours is based on average actual hours for FY97; therefore the PF&D is included in the estimate.

2. The standard of 1.5 hours is an estimate which did not include a PF&D allowance; therefore a PF&D of 10% was added to each suboperation. PF&D calculations are on file in the section office.

3. The standard is engineered; a PF&D of 10% was added to each suboperation. PF&D calculations are on file in the section office.

A6.7. Shop Flow Days (Commodities). The shop flow day calculation should be reviewed. If there were any changes to any of the factors going in to the formula, the shop flow days should be recalculated. Since indirect factors ("I" in the formula) are recalculated on an annual basis, it is important to calculate the formula with the latest factors. An annotation should be made, or a copy of the calculations attached.

Example of annotation:

Since the last review the indirect factor changed from 91% to 87%. The shop flow day calculations were revised accordingly.

A6.8. Labor Efficiency Factors. Projected labor efficiency factors are accomplished annually at or below RCC level in accordance with chapter 3. Complete documentation of the calculations must be maintained. Projected labor efficiency must not be based solely on history, as this can build inefficiencies into the sales price.

Example of Justification:

The hiring of 10 new employees, with a 1 year, 50% learning curve, will result in an overall labor efficiency factor for the work center of 90% (see attached calculation).

A6.9. Engineered Labor Standards. In addition to the above requirements, the following must be accomplished to engineered labor standards to maintain their status:

1. A methods validation will be accomplished. This will include sufficient observations of the elements to verify or to change their descriptions.

2. Current workplace layouts will be compared to the layouts on file to determine if any changes have occurred.

If either of these 2 factors have changed, the appropriate portion of the work measurement study will be reaccomplished and documented.

Attachment 7

REVIEW PROCEDURES (SAMPLING)

Table A7.1. Sample Size and Rejection Criteria

No. of Standards	Sample Size	Rejection Number
2 to 8	2	2
9 to 15	3	2
16 to 25	5	2
26 to 50	8	3
51 to 90	13	4
91 to 150	20	6
151 to 280	32	8
281 to 500	50	11
501 to 1200	80	15
1201 to 3200	125	22
3201 to 10000	200	22
10001 to 35000	315	22
35001 to 150000	500	22
150000 to 500000	800	22
500001 and over	1250	22

A7.1. Refer to Table A6.1, Sample Size and Rejection Criteria. Enter table with the number of active standards in the area being sampled (i.e., 1500 active standards, use 1201 to 3200 range).

A7.2. Read the sample size to take (i.e., 125). Find the number of rejected standards that requires rejection of the entire batch (i.e., 22). When a batch fails the entire population is considered to have similar flaws. The remedial actions to correct the sample batch need to be applied to the general population. A resample must be taken to confirm acceptable results.

A7.3. This group of standards (i.e., 125) may be prioritized by work load volume, but at least 25 percent of the sample must address the total range of standards.

A7.4. The following criteria is used to determine if an individual labor standard is accepted or rejected. Defects will be classified as critical, major, or minor. Any sampled standard that has one critical defect or four major defects will be considered a reject. No limitation is placed upon the number of minor defects a sample can have.

A7.4.1. Critical defects:

A7.4.1.1. Standard method is not commensurate with method being used.

A7.4.1.2. The total of any suboperations that are left out, or included but no longer required by TO, have an impact greater than the accuracy requirements on the standard being evaluated.

A7.4.2. Major defects:

A7.4.2.1. No reason for each labor standard time increase or decrease documented, or incorrect action reason code applied.

A7.4.2.2. Labor standard documentation requirements missing which impacts the traceability of the method and accuracy of the time. One defect per finding.

A7.4.2.3. Misapplication of work measurement techniques.

A7.4.2.4. Errors in labor standard time computations having impact greater than accuracy allowed.

A7.4.2.5. Misapplication of PF&D or supporting engineered backup studies missing.

A7.4.2.6. No evidence of a method analysis.

A7.4.2.7. No evidence of an operations analysis.

A7.4.3. Minor defects:

A7.4.3.1. Any documentation errors or other errors considered significant.

Attachment 8

SELECTING STANDARDS TO ENGINEER

Initial Assumptions:

1) Engineered labor standards are 14.6% to 34% lower than non-engineered standards.

Sources: The 14.6% is from *Industrial Engineering*, September 1973

Benjamin W Niebel, *Motion and Time Study*, and DoD IG Audit Report No. 95-049, found 25%.

DoD IG Audit Report 91-039 on airframes found non-engineered standards were overstated by 34%.

2) It takes 10 to 12 hours to engineer one DPSH, depending on the technique used.

Source: historical data for AFMC.

As an example, assuming a 14.6 percent productivity increase, and 12 hours to engineer one DPSH, for a 1 to 1 return on investment, you would engineer any operation which is performed at least 12/0.146 times per year, or 82 times.

For a payback period of 2 years, you would engineer any operation which is performed at least 12/0.292 times per year, or 41 times. A payback period of 3 years would engineer any operation which is performed more than 27 times per year.

It is suggested that several pilot studies be performed at each center on a sample of high-volume operations, and data kept on hours expended/standard changes. This new data could then be used instead of the abovementioned Assumptions to provide a more accurate return on investment projection for each individual center.

Examples:

Standard=100 hours, workload=100

Cost to engineer=100X12=1200 hrs

Savings=10,000X14.6%=1460 hrs/yr

Payback=1200/1460=0.82yrs

Standard=2000 hours, workload=10

Cost to engineer=2000X12=24,000 hrs

Savings=20,000X14.6%=2920 hrs/yr

Payback=24,000/2920=8.22 years

You would want to engineer the first example, because it provides payback in one-tenth the time of the second example, even though the second example has a higher DPSH.

Attachment 9

PERSONAL, FATIGUE, AND DELAY (PF&D) ALLOWANCES

A9.1. General.

A9.1.1. Personal, Fatigue, and Delay (PF&D) is the time allowed a worker to compensate for attending to personal needs, for fatigue, and for delay occurring due to conditions beyond his control. This time is additive to the normal time required to accomplish a job. The inclusion of this allowance is common practice in the development of a labor standard. Present practices for computing PF&D have resulted in varied interpretation of the factors being considered and the use of different techniques to establish them. Variances in application range from an allowance for each element within a standard to the adoption of a fixed or blanket allowance for all standards in an organization or activity. As a result of these different practices, standards for identical work are inconsistent and result in different measurement criteria for identical jobs or functions and incomparable data at the summary levels. In order to minimize these variances, it is necessary to establish a standardized method of computing the PF&D allowances. The guidelines for developing allowances portrayed in this attachment have been accepted and used extensively for some time throughout the Department of Defense, and are established as the standardized method.

A9.1.2. Where appropriate, a fixed PF&D allowance based on the standardized method may be developed one time for a specific function or for groups of personnel doing similar work under similar conditions. The fixed allowance applies to all standards in the function or group and precludes the need to individually compute the allowance for each standard. In work situations where the guidelines are not applicable, the fixed allowance will be developed through work measurement techniques such as time study or work sampling.

A9.1.3. The development and application of PF&D allowances requires that the various conditions under which a job is performed be examined and considered. To insure that all conditions are considered, separate factors are provided for each of the three areas: Personal, Fatigue, and Delay. Analysts/technicians must be completely objective in establishing the allowances which correctly reflect the true situations inherent to the job.

A9.2. Allowances for Personal Time. Consider the surroundings, working conditions, and job requirements which cause the employee to stop work from time to time to attend to necessary personal needs (go to restroom, get a drink of water, get fresh air, etc). Since most operations allow two breaks of 10 minutes each during the 480-minutes shift, the basic allowance for this factor will be 4.2 percent (20.0 minutes). If facilities layout or management policy dictate that longer break periods are required, it will be necessary to recompute the percentage for the Basic allowance subject to approval of higher authority.

	Percent
Basic Allowance	4.2
Add:,	
Normal office conditions	0
Normal shop, central heat, slightly dirty or greasy	1

Slightly disagreeable conditions. Exposed to inclement weather part of time, poor heating, or poor cooling 3

Exposed to extremely disagreeable conditions most of the time. Proximity to hot objects, continuous exposure to disagreeable odors and fumes, or to excessive temperature ranges 6

Add the following where applicable:

e. Where time is allowed by management at the beginning of the shift to make ready and/or at the end of the shift to get/put away tools and equipment, clean up work area, or to don/remove special work clothing (aprons, smocks, etc.) allowances are as follows:

TOTAL MINUTES ALLOWED FOR PREPARATION AND CLEANUP	% ALLOWANCE
5	1.0
10	2.1
15	3.1
20	4.2

f. In "super-clean" room conditions, supplement these allowances with an adjunctive allowance. Required when operators must utilize special clothing, which includes caps, boots, etc., and remove it when leaving work area. This includes time to invest or divest special clothing at beginning and ending of shift, at lunch, and for personal requirements 4.0

g. Where the work period is 8 consecutive hours and 20 minute lunch period is allowed at the expense of the government 4.2

A9.3. Allowances for Fatigue:

A9.3.1. Physical: Consider the average weight handled per man and only those elements of time that the man is under load to determine percentage (total time for under load elements divided by base time and use the closest percentage on the chart). Also, consider the height that load must be manually lifted (average situation).

Effective Net	Percent of time under load				
Weight Handled	1-12	13-25	26-50	51-75	76-100
1-10	0	1	2	3	4
11-20	1	3	5	7	10
21-30	2	4	9	13	17
31-40	3	6	13	19	25
41-50	5	9	17	25	34
51-60	6	11	22	x	x
61-70	7	14	28	x	x
71-80	8	17	34	x	x

x - Study individual job for improvement considering job enlargement, mechanical aids, worker rotation or other stress relieving aids.

Table values will be multiplied by the following factors as dictated by conditions:

For picking up loads from floor, multiply basic allowance by 1.10

For placing load above chest-height, multiply basic allowance by 1.20

For getting load from above chest-height, multiply basic allowance by 0.50

The application of the factors from this table in the computation formula in section A9.5 will normally provide a realistic PF&D allowance. However, in some instances the use of these factors results in an unrealistic, zero or negative denominator in the formula. When this occurs, assuming all factors are defined correctly, it will be necessary to combine related elements or standards into higher levels until a realistic allowance is obtained. "Realistic" is defined as an allowance acceptable to the worker, the supervisor, and the analyst.

b. To determine the effective net weight for sliding or rolling objects the weight must be multiplied by the following coefficients of friction (average values):

Surface	Friction Coefficient
Wood on Wood	0.4
Wood on Metal	0.4
Metal on Metal	0.3

Example: Worker sliding a 40 lb. casting from metal conveyor to wooden work bench.

ENW = 40 lbs. x .4 = 16 lbs.

c. Position: Consider the position which the employees must assume to perform the operation. Select the class which best describes the average condition. It is assumed that the job will be less tiresome if the position can be varied frequently.

Class	Percent
a. Sitting or standing	0
b. Sitting	1
c. Walking	1
d. Standing	2
e. Climbing or descending ramps, stairs or ladder	4
f. Working in close, cramped position	7

A9.3.2. Mental: Consider the degree of concentration necessary to perform the job and the amount of variety in the tasks. Highly repetitive jobs should be low in this factor.

Class	Percent
Work largely committed to habit; simple calculations on paper; reading easily understood material such as routine or familiar instructions; counting and recording; simple inspection requiring attention but little discretion; arranging papers by letter or number	0
Work requires full attention; copying numbers, addresses or instructions; memory of part number, name while checking stock or parts list; simple division of attention between work at hand and jobs of others, conveyor, or time schedule; simple calculations in head; compiling papers by subject of familiar nature	2
Work requires concentrated attention; reading of nonroutine instructions; routine calculations on paper such as long division and four-place multiplication; checking numbers, parts, papers, etc., requiring cross check or double check; division of attention between three components such as accounting, inspecting, and grading or driving over unfamiliar route, watching vehicle, traffic and route signs	4
Work requires deep concentration, swift mental calculations or calculations on paper; memorizing; inspection work requiring interpretation and discretion of unfamiliar nature, as when working against nonroutine specifications; highly divided attention between phases of work, operations of others, hazards etc.	8

A9.3.3. Lighting: Consider the amount of light on the working surface in relation to the fineness of details upon which the operator works. Consider the amount of glare on the work surface and rapid changing or "hypnotic" effect on the work surface.

Class	Percent
Continual glare on work areas; work requiring constant change in light on work area. Less than 75 foot candle power on work surface for normal job. Less than 125 foot candle power on work surface for close work	2

A9.3.4. Noise Factor: Consider the general noise of the work areas as well as any annoying, sharp, staccato, or intermittent noises occurring during more than 50% of the work day. If ear plugs or ear muffs are worn, their sound deadening effect must be considered when using this allowance.

Class	Percent
Constant, rather loud noises such as in machine shops, motor test shops, etc. (over 60 decibels)	1
Average constant noise level but with loud, sharp, intermittent, or staccato noise such as nearby riveters, punch presses, etc. (Example: sheet metal shop)	2

A9.3.5. Monotony: Consider the fatigue resulting from fast, highly repetitive operations. The cycle time is the time elapsed from starting one element until the same element is started again.

Cycle Time	Percent
a. 0.00-0.20 minutes	4
b. 0.21-0.40 minutes	3
c. 0.41-0.80 minutes	2
d. 0.81-2.50 minutes	1
e. 2.51 minutes or more	0

A9.3.6. Restrictive Safety Devices and Clothing: Consider those devices which are required by the job and which cause fatigue when worn. No allowance should be made here unless it is necessary to remove the device occasionally for relief, or if wearing them causes fatigue. If more than one device is required, add the allowances.

Class	Percent
a. Face Shield	2
b. Rubber boots	2
c. Goggles or welding mask	3
d. Tight, heavy protective clothing	4
e. Filter mask	5
f. Safety glasses	0

A9.4. Allowances for Delay. Consider the job in relation to adjacent jobs--how long can any adjacent job be shut down before the job being studied is affected? Also, consider other delays inherent in the job, such as supervisory interruptions, moving from one work station to another, waiting for cranes, etc. No delays which can be prevented by the employee should be considered here.

A9.4.1. Basic Allowance

Class	Percent
a. Isolated job. Little coordination with adjacent jobs	1
b. Fairly close coordination with adjacent jobs	2

A9.4.2. Balancing Delay. Where employees are required to move from one work station to another to balance adjacent stations, add the following:

a. Move once each 5 minutes 5

b. Move once each 30 minutes 3

c. Move once each 60 minutes 2

d. Move once each 2 hours 0

A9.4.3. Special Delay Allowances.

A9.4.3.1. Except for the above, there will be no predetermined or generally used delay allowance percent that is applied without an engineered backup study. An appropriate study must be conducted in each shop or functional area to ascertain additional delay allowance requirements.

A9.4.3.2. All noncyclic work elements will be apportioned in the manner that will most accurately add their cost to the product cost. Work elements such as cleaning chips and tool care and replacement, though occurring on an irregular basis, can be measured and the time required prorated directly to the machine operating portion of the work cycle rather than as an allowance. Certain other irregular occurring elements having a direct relationship to the job, such as obtaining parts and materials and periodic inspection, should be added to the cycle time on a prorated basis or as a separate work element rather than added as an allowance. Again, care should be taken to assure that there is no duplication between cycle time elements and allowance elements. The delay allowance must not be used as a "dumping ground" for operation activity not an integral part of the work load in the shop.

A9.4.3.3. Special delay allowance elements fall into two categories: (1) those which occur on a non-foreseeable basis (power failure, minor repairs to defective parts, wait for job assignment), and (2) those which occur on a time basis (daily, weekly, hourly). The following are examples of the type of special delay which can be considered for allowance:

1. Obtain job information from supervisor, inspector or production control.
2. Wait for special tools already being used if waiting time cannot be eliminated.
3. Power failure of non-reportable duration.
4. Work interference.
5. Minor rework elements if not caused by operator error.
6. Extra work required due to hidden part or material defects, if minor.
7. Unsuccessful hunts for parts or materials.
8. Machine breakdown of non-reportable duration.

A9.5. Application of Allowance

A9.5.1. Expression as Percentage. The factors provided in this procedure are expressed as a percentage of 480 minutes (eight hours). Since the productive time in the work day is a variable inversely proportional to the amount of PF&D allowance, it is necessary that all factors are expressed as a percentage of the total work day in order to provide a constant base. It is therefore necessary that all locally determined factors are similarly expressed.

A9.5.2. Computation Procedures.

A9.5.2.1. Percent of Work Day. The application of the allowances requires that the total percent of PF&D allowance be determined first by adding the percentage for the applicable factors of the productive day before it can be applied. This is accomplished by dividing the total work day by the productive day expressed as a percent of the work day, i.e.,

$$\text{Allowance Factor} = \frac{100\%}{100\% - \text{allowance (\% of the work day)}}$$

Example: Assume all factors total 15 percent allowance (this is 72 minutes of the 480 minute work day). Converting this allowance to a percentage of the productive day (408 min.) results in an allowance of 17.6 percent.

$$\text{Allowance Factor} = \frac{100\%}{100\% - 15\%} = \frac{100\%}{85\%} = 1.176$$

If allowances are expressed in minutes:

$$\text{Allowance Factor} = \frac{480 \text{ min.}}{480\text{-}72 \text{ min.}} = \frac{480 \text{ min.}}{408 \text{ min.}} = 1.176$$

A9.5.2.2. Application to Normal Time. The final step in the application of the allowance is to multiply the normal time by the allowance factor. For example, assume the rated productive time to be 408 minutes, the job standard would be:

408 minutes X 1.176 = 480 minutes

A9.5.3. Examples of Application

A9.5.3.1. Unloading Boxes from Truck

a. Job Conditions - Crew is unloading boxes from a truck and placing them on a pallet and the following conditions are in effect:

(1) The operation is performed at a warehouse ramp.

(2) The boxes weigh 25 pounds each and the employee is under load 25% of the time.

The boxes are being taken from stacks slightly higher than his waist and are placed on pallets resting on the truckbed.

The work is purely routine.

The employee walks approximately five feet with each box.

The cycle time (per box) is .500 minutes, actual under load elements equal .125 minutes (if per pallet the % may be somewhat less).

No restrictive safety devices are required.

A forklift operator is considered a part of the unloading crew.

b. Computation and Allowance <u>Percent</u>

Personal

Basic 4.2

Class B Slightly disagreeable, exposed to weather 3.0

Fatigue

Physical – 25 pounds handled 25% of the time (total under load element time, .125 divided by cycle time, .500 = 25%) 4.0

Mental – Class A – work committed to habit 0.0

Position – Class C (walking) 1.0

Monotony – Class C (0.50 minutes) 2.0

Delays

Class A. Little coordination with adjacent jobs..1.0

TOTAL ALLOWANCE 15.2%

c. Allowance Factor

$$AF = \frac{100\%}{100\% - 15.2} = \frac{100\%}{84.8\%} = 1.179$$

d. Computation of Standard

If this operation is studied and the normal time is determined to be 0.500 minutes, the standard time would be computed as follows: 0.500 x 1.179 = 0.590 standard minutes. The number of decimal places used would depend on the time increments used in the manhour accounting system and the volume of production.

A9.5.3.2. Aircraft Instrument Assembly

Job Conditions

An employee receives tray of parts and assembles small aircraft instruments. Completed instruments are delivered to outgoing window in clean room. Cycle time is 15 minutes.

Work is performed in "super" clean room.

No formal break periods have been established, but employees are free to attend to personal needs as necessary.

Instrument weighs less than one pound.

No clean up period at end of shift.

Employee performs work seated at work bench.

No restrictive devices are required.

Only occasional visual and mental concentration required.

Unavoidable delays have been established at 5% by separate study.

b. Computation of Allowances	Percent
Personal	
Basic	4.2
"Super" clean room	4.0
Fatigue	
Position-sitting	1.0
Unavoidable Delay	5.0
TOTAL ALLOWANCE	14.2%

c. Allowance Factor

$$AF = \frac{100\%}{100\% - 14.2\%} = \frac{100\%}{85.8\%} = 1.166$$

d. Computation of Standard

Standard time is computed in the same manner as shown in the preceding examples.

A9.5.3.3. Contract Administration

Job Condition – An employee is performing in a technical capacity administering contracts. The following conditions are in effect:

The operation is performed in a normal office.

The employee reviews and prepares contractual documents, contacts contractor or other government personnel for obtaining information or resolving problems, and participates in meetings.

The work requires a combination of deep concentration and concentrated attention.

The employee is primarily sitting but does change positions throughout the work day (i.e., not restricted to desk).

Operations vary in cycle time and content.

No restrictive devices are required.

Delays are inherent in the job. Employee has the ability to shift to other operations when delays occur.

b. Computation of Allowance <u>Percent</u>

Personal

Basic 4.2

Fatigue

Mental – work requires deep concentration 50% time and concentrated attention 50% time ..6.0

Position – sitting 1.0

Monotony 0.0

Delay

Isolated Job 1.0

TOTAL ALLOWANCE 12.2%

c. Allowance Factor

$$AF = \frac{100\%}{100\% - 12.2\%} = 1.139$$

d. Computation of Standard

Standard time is computed in the same manner as shown in the preceding examples.

A9.5.3.4. Preparation of Voucher

Job Conditions

An employee is preparing a voucher for payment. The following conditions are in effect:

The operation is performed in a normal office.

The work requires full attention. Employee must check request for payment against contract clauses, make calculation on calculator and prepare voucher.

Employee accomplishes job at desk but may change routines to obtain additional data.

Cycle time of operation is 20 minutes.

No restrictive devices are required.

If flow of work is cut back, operation would have to be shut down or curtailed.

b. Computation of Allowance Percent

Personal

Basic 4.2

Fatigue

Mental – Work requires concentrated attention 4.0

Position – Sitting...0

Monotony 0.0

Delay

Fairly close coordination with adjoining jobs 2.0

TOTAL ALLOWANCE 11.2%

c. Allowance Factor

$$AF = \frac{100\%}{100\% - 11.2\%} = 1.126$$

d. Computation of Standard

Standard time is computed in the same manner as shown in the preceding examples.